The Tool Engineer

Vol. IV. No. 6.
October
1935

IN THIS ISSUE

SEE PAGE 36

Official Publication of the

AMERICAN SOCIETY OF TOOL ENGINEERS

No. 49 Bore-Matic . . . UNIVERSALLY ARRANGED

FOR SMALL LOT PRODUCTION OF A VARIETY OF PARTS

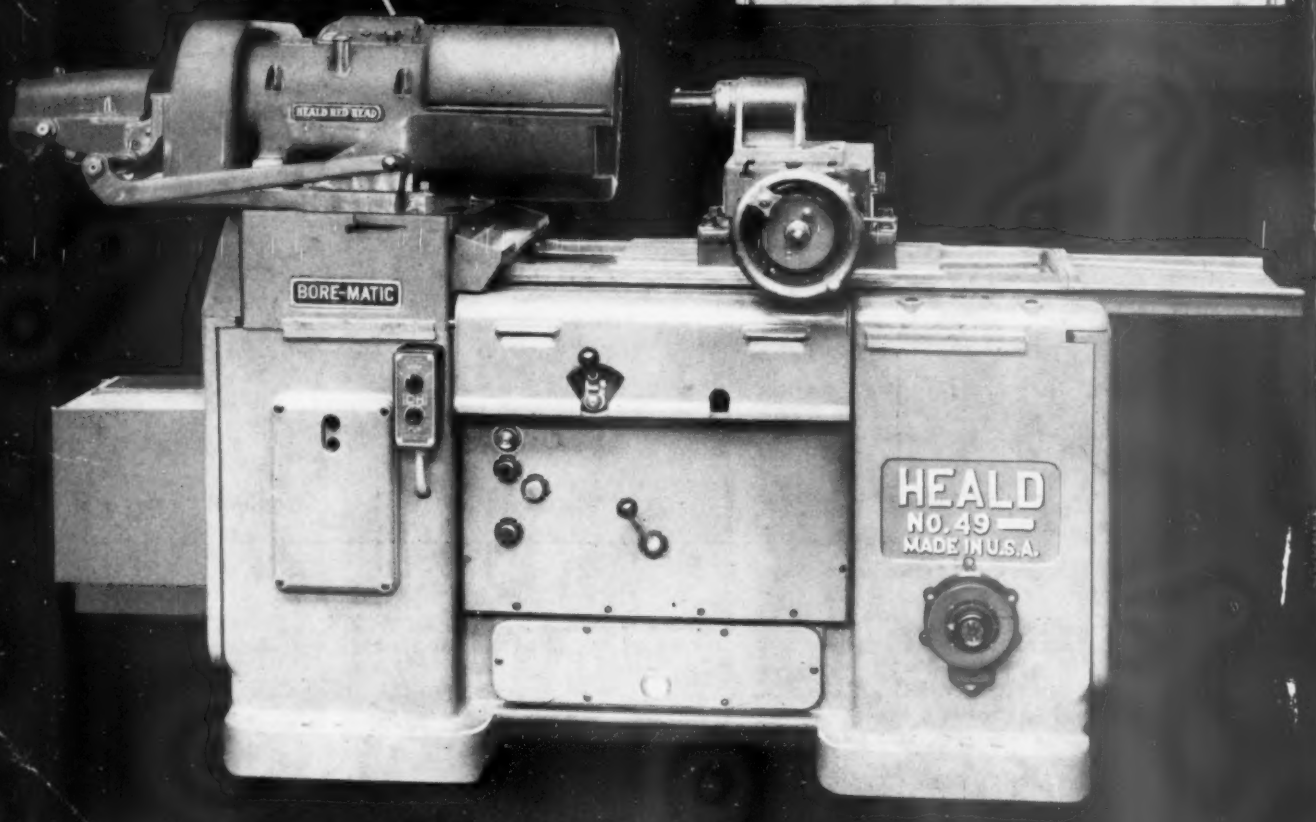
HERE is a precision boring machine that is exceptionally universal in its operation. It is easy and convenient to set up and will bore, turn or face either straight or angular work. It is ideal for small lot production of a variety of parts such as might be found in a machine tool shop.

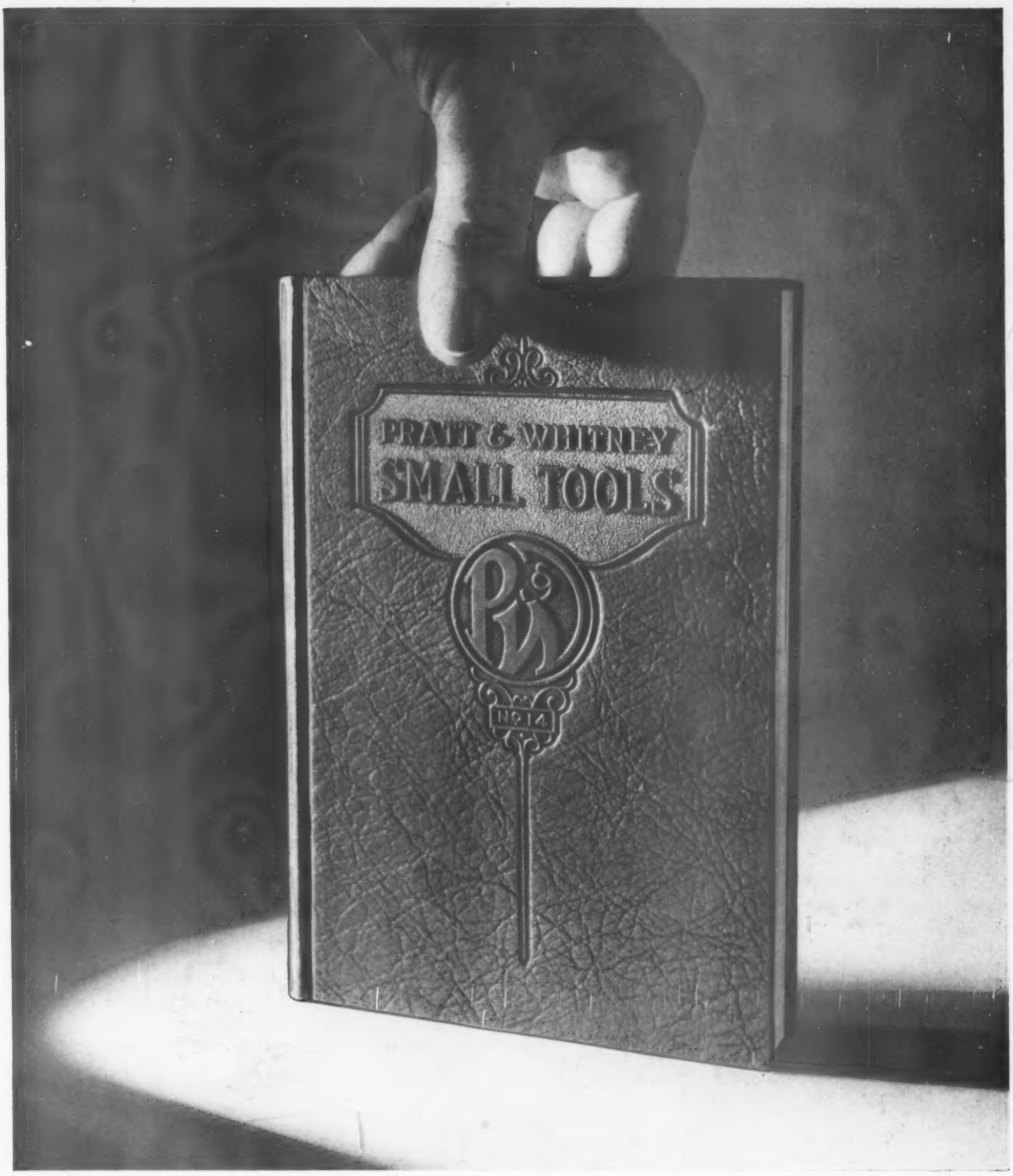
This machine is of sturdy, rugged construction with a single bridge having a swivel plate upon which is mounted a single boring head or workhead. Where a workhead is used on the bridge, it can be equipped with a draw bar operating unit for chucks or collets.

A manually operated cross slide is mounted on the table for either work fixtures or tool holders. With this arrangement work will be held in a rotating chuck or a stationary fixture on the table and likewise the cutting tool may be either the rotating or stationary type as occasion requires.

The standard Heald Bore-Matic controls and drives are used throughout.

THE HEALD MACHINE COMPANY
Worcester, Massachusetts, U. S. A.





This new book, fresh from the press, will be sent free to any executive requesting it on his company's letterhead . . . .

PRATT & WHITNEY CO. Hartford, Conn.

The Tool Engineer

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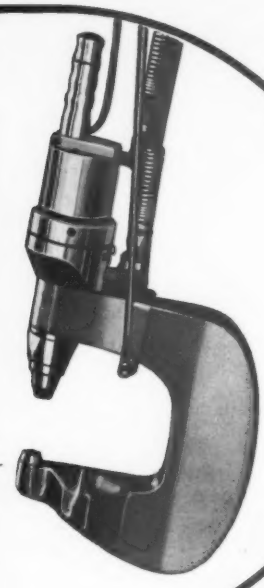
Principal Features, This Issue

★ Do you know that a branch of the American Society of Tool Engineers is being chartered at Racine, Wisconsin? See the next issue of *The Tool Engineer* for full details. Other branches are also being formed in other parts of the country. Read *The Tool Engineer* every month for news of mass manufacturing from everywhere.

A NEW KIND OF PRODUCTION RIVETING



- **Faster**—Riveter cycle 2½ *seconds* per rivet. (⅜-inch rivets)
- **Easier**—Portable yoke riveter weighs only 54 lbs. Spring suspension and convenient controls simplify handling. No bucking up.
- **Better**—35,000 lbs. maximum pressure on the dies heads the rivet *tight.*
- **Compact and Economical**—The hydraulic pressure generator is driven by a 2 hp. motor, and requires less than 4 square feet of floor space.
- **Push Button Control**—A single button on the handle of the yoke riveter controls the entire operation.
- **Automatic Hydraulic Power Unit**—The hydraulic pressure generator has automatic electric valve and oil pump controls giving an automatic riveter cycle actuated by the push button control. Oil pump idles at zero pressure between cycles.
- **Safety Features**—No repeat: push button must be released and pressed again for another stroke. Instant Safety Stop: releasing the button at any point in the cycle automatically returns the riveter ram to starting position.
- **Noiseless**—Hydraulic operation means quiet—less fatigue and sustained production.
- **This Combination** of large capacity, light weight portable unit, and high speed operation has already proved its remarkable value in a number of different production operations. Investigate the application of these features to your work. A number of variations in both portable and stationary riveting units are available.

HANNIFIN MANUFACTURING COMPANY

ENGINEERS • DESIGNERS • MANUFACTURERS • *Pneumatic and Hydraulic Production Tool Equipment* • 621-631 SO. KOLMAR AVE., CHICAGO, ILL.

Detroit Office:
Hayward Building, 4829 Woodward Ave. • Phone Columbus 4949 • R. A. Bean, Manager

PORTABLE YOKE RIVETER: Throat of yoke 6 x 6 inches, weight 54 lbs. With 4-inch reach, weight 47 lbs. Capacity ⅜-inch cold rivet. Stroke 3 inches.
HYDRAULIC PRESSURE GENERATOR: Completely automatic valve and oil pump control. Working pressure 5,000 lbs./sq. in. Motor 2 hp. Dimensions 32 x 17 x 56 inches.
OPERATION: Automatic riveting cycle controlled by a push button on yoke handle. Cycle includes rapid advance at moderate pressure, automatic high pressure when die touches rivet, and reversal at peak pressure with rapid return to starting position. At end of return stroke controls automatically move to neutral and oil pump idles at zero pressure.

HANNIFIN

"hy-power" PORTABLE HYDRAULIC RIVETER

OCTOBER MEETING

(DETROIT)

OCTOBER 10th, 1935

FORT SHELBY HOTEL BALLROOM

DINNER: 6:30 p. m.

MEETING: 8:00 p. m.

SPEAKER: Dr. W. A. Dean, Research Metallurgist, Aluminum Company of America, Cleveland Ohio

SUBJECT: Uses and Machining of the Newer Heat Treated Alloys

▲

Dr. Dean graduated from the Renselair Polytechnical Institute in 1929. He has been working at his profession continuously and at present is doing considerable work on free cutting alloys.

His talk will cover aluminum generally and will deal specifically with uses and machining of new heat treated alloys.

▼

COME EARLY TO ENJOY THE SPECIAL ENTERTAINMENT WHICH WILL BE PROVIDED.

PRODUCTION PERSPECTIVES

WELL, the Show is over but not forgotten. It was a lot of "grief" for almost everyone connected with it, but well worth the effort and expense involved. Tool Engineers from everywhere came to Cleveland to see and buy and plan. From the new developments and the unmistakable courage to go ahead and spend big money on the part of the Machine Tool Industry we just know big things are ahead. One speaker at Cleveland—and he's in a position to know—said in effect that we are slated, now, for a prosperity the like of which the good old U.S.A. has never known. That's something, but—**read the story about the show on page 13** of this issue, even if you were in Cleveland, for there are facts and figures given which you will want to know about.

The Cleveland Terminal Tower as it appeared at night and nearly always visible from any point in downtown Cleveland. It is the one thing all Tool Engineers saw and remembered aside from the Show itself.

Every contact we have had with Tool Engineers indicates greatly **increased activity—particularly in the Detroit** area, and we note a **big improvement** in the **Milwaukee territory. Cleveland** also has **plants going back into production** which have been practically idle for several years. **Meadville,** Pennsylvania is **another busy spot** on the Tool Engineer map. Nearly all **New England machine and tool** plants have **many unfilled orders.** In Cleveland the **Elwell-Parker Electric Company** has awarded contract for the erection of a large **factory addition** running from two to four stories high and 100 x 120 feet in area. The old Newburg steel works in Cleveland are being torn down. They had been closed for two years. Ingot requirements of **American Steel and Wire** plants in the Cleveland district are now supplied from the Loraine plant of National Tube Co.—U. S. Steel subsidiary. The **Cleveland Hobbing Machine Company is building a $20,000 addition** to their plant at 1170 East 152nd Street. It will be used for plant, drafting room and more office space. While attending the Show **William H. Hunter,** Chicago District Manager for Pratt & Whitney, died suddenly due to a heart attack. He leaves a wife and two children. Burial was at Philadelphia. **Daniel Loew,** who founded the Loew Manufacturing Company, of Cleveland, died at his home in Lakewood, September 10th at the age of 77. He had been retired from active business since 1920.

Flolock Valve Insert corporation recently filed articles of incorporation for the purpose of manufacturing valve inserts and other mechanical devices. Headquarters are established at 604 Peoples Trust Building, Ft. Wayne, Indiana. At Kokomo, the **Kokomo Steel Products Corporation,** recently incorporated **has begun operations.** The incorporators are Maurice M. Feuerlicht, Gustave H. Dongus and Jennie Henshaw, all of Detroit.

Wayne Eddy, formerly Master mechanic of Buick and well known in the auto industry **has joined Packard** Motor Car Company in the capacity of Assistant Vice-President of Manufacturing. **S. R. Anstey,** who is well known in the metal working industry in **Philadelphia** and surrounding area, is in charge of a newly opened assembly plant and branch office of Danly Machine Specialties at Philadelphia. **White Motor has jumped into heavy production** with new stream lined truck models. The Cleveland headquarters have had a comprehensive tooling program and already have many unfilled orders for the new model truck which is a completely streamlined job — "from front bumper to tail light."

A.S.T.Eers from all sections of the country will be pleased to know that a **new chapter of The Society is being chartered at Racine,** Wisconsin in the very near future. **Other branches** are being **organized in Cleveland, Buffalo, Rockford, Ill., and Chicago. Norman G. Brownsward,** A.S.T.Eer who will be remembered as the winner of a prize turkey at an A.S.T.E. meeting in Detroit last fall, has been employed as a Tool Engineer by the United States Government in Washington. His assignment is now completed and Mr. Brownsward will return to Detroit, we understand.

Members of A.S.T.E. and friends of **Professor John Younger** will be pleased to learn of his election to Honorary Life Membership in the American Society of Tool Engineers. The certificate of Honorary Membership was awarded to Professor Younger at the A.S.T.E. session of the Machine Tool Congress in Cleveland, September 13th at the Statler Hotel. Mr. Younger is the first to be so honored by The Society. Increasing interest on the part of A.S.T.E. members is shown by the recent ballot returns. All members were asked to **vote for Board of Directors** for the coming year. Returns have, so far, exceeded all previous returns. **Harold Gillette** is the new Assistant Secretary of the A.S.T.E. The growing burden of this office has necessitated the employment of Mr. Gillette, who will devote his entire time to the affairs of A.S.T.E. Heretofore Secretary A. M. Sargent has carried on all the work of his office, but the increasing activities as well as a constantly growing membership necessitated someone to devoting full time to the duties of this office.

EDITORIAL

THE PLACE OF A.S.T.E. IN THE ENGINEERING FIELD

By

A. E. RYLANDER

Member A.S.T.E.

WHEN an organization grows as rapidly as the American Society of Tool Engineers, and when, while yet an infant it is accorded a place on the program of the Machine Tool Congress, several questions come naturally to mind.

"Who are they, these Tool Engineers?" . . . . . "What is the policy of the Society?—what are its aims?—its scope and limitations? Will it maintain the high standards of the engineering profession? Will it maintain prestige?—engineering ethics?"

Now, these are live questions, because they have been asked. Taking them in their order, the first has been adequately answered by O. B. Jones, cofounder of A.S.T.E. in a previous issue of *The Tool Engineer*. The Tool Engineer is the production man, the master mechanic, the designer or planner who plans production methods and is responsible, to a greater or lesser degree, for mass production of parts. He buys, or recommends the purchase of tools, machinery and mechanical equipment, or, if a contractor, sells a set-up to his client. Under various titles which have prevailed in the past, he is now grouped under one heading—Tool Engineer.

The policy of the Society has been quite definitely outlined. It is so nearly in harmony with the purpose of the Machine Tool Congress that this, printed on the Program, can be paraphrased with only one addition; italicised below: "To provide a neutral forum, wherein engineers, users, distributors and producers may discuss freely all questions of mutual interest concerning the design and utilization of machine tools *and special production* equipment." In italicised class may be included jigs, fixtures, cutting tools, holding devices etc., which do not come under the scope of machine design and manufacture proper. Also, may be included methods, handling, hardening and heat treating, cooling and lubrication during process. In brief, the A.S.T.E. is a forum where engineers with mutual problems may exchange ideas and improve methods of production. In this, may also be included its scope and limitations, except that it also chooses to lighten its serious work with good fellowship and the requisite amount of play. Jack Tool Engineer does not propose to be a dull boy, nor yet, a playboy. Business *before* pleasure.

A.S.T.E. as an organization is interested in tools; if it encroach on the domains of other engineering societies it is merely for the purpose of insuring equipment suited to the particular demands of its membership. Mr. Smila's paper, at the Machine Tool Congress; "Standardization of Machine Tool Data.", covered this phase of the Society's activities.

"Will it (the A.S.T.E.) maintain the high standards of the engineering profession . . . . prestige . . . ethics?" The answer is, obviously, yes. Founded on high ideals, it has stuck to its principles. Its place in the engineering field is not a promise, but an accomplishment. The A.S.T.E. has won merited recognition. It has *arrived*.

MEN AND MACHINES

To discuss temporary displacement of labor by machines and not to consider the creation of employment opportunities by machines is an unsound method of analyzing the social and economic effects of technological progress. The National Industrial Conference Board is making a survey of mechanization in industry and technological progress with a view to showing the part the machine has played in our national economic progress.

"Ever since the dawn of the industrial revolution, says the Machine Tool Builders' Association," mechanization of industry has been denounced by some writers as the greatest problem concerning labor. From the early nineteenth century, when the textile industry was first organized on a more mechanized basis, causing temporary loss of employment to thousands of weavers, to this day when automatic motion has taken the place of hand and semi-automatic operation, permanent technoligical unemployment has been prophesied as an inevitable result of the machine age. Instances have often been cited as evidence of such contentions, where one or another machine would supplant the use of five, ten, fifty or one hundred workers. The usual and misleading inference from such statements is that mechanical devices throw permanently out of work as many persons as they displace.

"Labor economies are instituted for the same reason as the majority of reforms in business—the desire to increase the profitableness of the undertaking in order to provide assured existence of the enterprise and continued employment of its personnel. "When the installation of a labor saving device makes possible a decrease in the price of the finished product, the scope of the market for the product is as a rule increased. It brings the article within the price range of a wider market and as a result more units are sold. "Thus machines, by decreasing cost prices, stimulates sales and effect a fan-like movement of employment spreading throughout innumerable fields of our industrial system.

"The degree to which this employment movement will take place depends upon a multitude of factors; such as, the character of the goods produced, the elasticity of demand, the relation to allied industries, and so forth.

A.S.T.E. Inaugurates Program of STANDARDIZATION of TOOL ENGINEERING DATA

As given before the A.S.T.E. Session of the Machine Tool Congress, Hotel Statler, Cleveland, September 13th, 1935.

by

W. H. SMILA,

Member A.S.T.E.

Master Mechanic, Chrysler-Jefferson Plant, Detroit, Michigan.

THE Standards Committee of the American Society of Tool Engineers has recently developed a machine and tool data sheet. This sheet is designed to give all pertinent information relative to the machine tool, small tool, equipment or accessory being described and presents it in such a manner that it will be of real value to the Tool Engineer, Tool Designer, Master Mechanic, Plant Engineer and all production executives in general.

These sheets are the result of a careful study and analysis of existing reference books, data sheets and specifications published by machine tool builders, vendors of mechanical equipment and trade journals. The material reviewed, while indicative of an earnest desire on the part of the publisher and sponsor to furnish necessary information to the engineer, varies greatly in scope and manner of presentation. It is often incomplete and therefore causes delay due to the necessity of obtaining further information by correspondence, wire, or by contacting the manufacturer or sales representative personally.

The descriptive catalogues, pamphlets, folders and loose leaf material now comprising the tool engineer's source of information do not permit of orderly filing for ready reference. It is intended that all reference data required by the tool engineer be filed in one or more loose leaf binders properly indexed for ready reference.

Where specifications are vague or inadequate, and time is pressing, the designer is often tempted to use a unit with which he is either familiar, or concerning which full information is readily available. This compromise lowers efficiency while the maker of a superior piece of equipment suffers the loss of sales because of incomplete data. The A.S.T.E. standard data sheets will be devoid of sales comment. They will provide the tool engineer will all necessary information for production planning and plant layouts. They will provide the tool designing department with all necessary dimensions and other data required.

The prime objective of the standard data sheets is the conservation of time and elimination of error. Machine proportions, range, and clearances will become a matter of certainty rather than of guess work or judgment. This will facilitate checking and lighten supervision. These data sheets will eliminate measurement of the same machine by various designers. Design will be expedited because of information at hand, already checked.

These data sheets will provide all necessary dimensions to reproduce, to scale, any unit or appliance to be incorporated in a layout. Customer and vendor alike will be spared the expense, annoyance, and delay of correspondence relating to specifications. So, without other literature than the data necessary for transfer to working drawings, the standard data sheets will prove an important factor in promoting sales.

Obviously, extreme uniformity is neither possible nor desirable in the machine tool and small tools field, nor in the manufacture of machine appliances, and the A.S.T.E. Standards Committee has no such end in mind. Its aim is the assembling and distribution of complete information regarding dimensions, capacities and limitations of machine tools and appliances, with all necessary data and specifications, reserving, however, the right to suggest standardization when sound common sense dictates that competitive equipment be interchangeable. In this work, the American Society of Tool Engineers extends its fullest co-operation and urges a reciprocal co-operation on the part of builders and vendors of machine tools and production equipment.

The Standards Committee of the A.S.T.E. is prepared to review all data sheets submitted by the various manufacturers; and to offer advice and suggestions regarding type and character of materials submitted; and to check same in relation to the specific information required by the engineer. To function to the best mutual advantage, this committee should be permitted, not only to check the manufacturer's data sheets before printing, but should be given opportunity to review printers' proofs to insure rigid adherence to standards.

The standard machine tool data sheets will make available and immediately at hand, all information required by the Millwright, Plant Layout, Plant Engineering, Methods and Equipment, Time Study, Tool and Die Design, and Efficiency Departments, which would be necessary to facilitate the purchase, installation, and the design of tools, dies, jigs, fixtures, face plates, special heads, cutting tools, holders, etc., as well as installation and addition of commercial accessories and appliances.

Standard data sheets will provide all information concerning floor space and the maximum area required, allowing for table travel (as in planers, grinders, milling machines, etc.) and also position of the operator. They will indicate requirements where a special foundation, pit or superstructure is necessary. They will specify total weight of machine (gross and net). They will contain all information concerning the type of motor, its HP and RPM. Full information will be supplied where belt, chain, friction, or hydraulic drives are used, together with speeds of complementary units, and relative posi-

tions of motor drives, countershafts, or driven pulleys, in at least two planes. In every case each step of spindle speed and each step of feed must be specified. Remote controls will be indicated, in case they are provided or available.

Complete data will be given on machine lubrication and type of oiling system, whether the machine requires auxiliary connections to air and at what pressure, oil, water, steam, or electricity; whether controls for these are furnished with or are a part of the machine equipment. Where a cutting compound is used, information will be given regarding the make of pump, its capacity, and whether motor belt, chain, or gear driven; whether the machine is automatic, semi-automatic, or hand operated; whether the machine is hand-loaded, magazine, or hopper feed. They will specify the type of bearings and whether ball, roller, or plain. The location of the manufacturer's serial number will be given. The manner of changing feeds and speeds, whether by pickoff gears, manual, magnetic or automatic will be given.

In addition to the foregoing, the standard data sheets will carry spindle dimensions, as to taper, nose, and tapped holes. They will show table dimensions, size, and center distances of the slots, travel and when provided, vertical feed. The maximum and minimum distances from spindle nose to edge of table will be shown, as well as maximum and minimum distances from center of spindle to working surface of table. They will show knee and column bearing dimensions and dimensions of over arms, etc., so that provision can be made for bracing or for attachment of accessories, and all general clearances which may affect tooling limitations. They will show clearance of feed handles and projections, whether clockwise, or counter-clockwise rotation of spindle, whether or not reversible, and whether machine is provided with power feed and return.

The standard data sheets for turret lathes, chucking and collet type machines will specify maximum and minimum clearances over cross slide; whether front and rear tool blocks can be operated independently; the size of tee slots and center distances between slots, in relation to each other and in relation to front and rear blocks; whether cross slide can be traversed (as a carriage) and whether or not it can be operated by a power feed; the full feed travel of turret slide exclusive of travel required to index; the diameter or distance across flats of the turret; size of turret holes; and, on flat faced turrets, either diameter or size of face, also exact center of screw holes in relation to turret hole; and other general dimensions as outlined under "Machine Tools in General." Specification will be given as to the maximum collet size and maximum size of piece which can be chucked.

The standard data sheets for single spindle drilling machines will also give such information as size of table, whether round or rectangular, indicating both working and overall dimensions when oil troughs are provided; size of tee slots and their relation to each other and to spindle or column; center distances from spindle to column, travel of spindle, maximum and minimum distance from spindle to top of table; dimensions of column bearing, diameter if round, or size and angle of slide; O.D. of spindles and quills; size of feed rack, its projection from centerline of spindle; dimensions of spindle nose; size of taper, etc., and size and location of thrust bearing. Information will be given as to whether the spindle has power feed and the maximum size of drill in steel which the machine will handle. Complete information will be given to permit the design and attachment of multiple spindle drill heads.

Information will be given on standard data sheets for punch presses as to maximum available working area on bolster plate and also on ram, length of stroke, maximum and minimum shut height, number of strokes per minute, total press pressure, and all other information which is generally required.

The standard data sheets for external, internal and surface grinders will specify maximum size of work which can be handled, what work holding and driving devices are included as standard equipment, maximum and minimum size of wheels which can be used and any special data which may be necessary to tool these machines.

The standard data sheets for air presses and riveters will specify maximum pressure of the ram at eighty-five (85) pounds line pressure, size of air cylinders and whether single or double acting, and complete dimensions of base and ram to which tools can be attached.

In case of appliances and mechanical equipment the standard data sheets will give dimensions, specifications, and data so the unit can be drawn to scale in relation to a machine with which it is to be used.

In the final analysis, all mechanical equipment, whether machine tool, appliance, accessory, or small tool, will be so specified and dimensioned that all salient features can be drawn to scale, in any layout or design of which it is to be a part, with assurance that it can be adapted to the limitations of space available.

The standard single two-page data sheet measures 8½"x11" with a ⅜" border on three sides and a ¾" border on the fourth or binding side of the sheet. On this side three 17/64" holes are accurately punched so that these sheets will fit a commercial three ring binder of the type available from the ten cent store variety up to the full leather models. Double or four page and triple or six page sheets can also be used if desired although we favor the use of the single sheet wherever possible.

These sheets will be printed on an 80 lb. rag stock, white and of a good finish, resistant to tearing, cracking, moisture, dirt and grease so as to insure good wearing qualities.

The printing will be done in black ink and specifications as to the kind of type to be used have also been established.

The indexing will follow the indexing of the Encyclopedia Britannica so that sheets can be continually added and readily located without the use of a table of contents or index. Across the bottom of the sheet on both sides and in a space not to exceed an inch in height will appear the manufacturer's name, trade mark, mailing address, etc.

In manufacturing plants where there is an annual

(Continued on page 18).

ELECTRONIC CONTROL

A NEW TOOL FOR THE TOOL ENGINEER

By RALPH A. POWER,
CHIEF PHYSICIST
Electronic Control Corporation, Detroit

THE operation of the electronic tubes is not new—the electron theory bears out experiments that are years old—in fact the "electric eye" or photo-electric cell is over fifty years old; and yet it has only been within the past few years that this ever increasing family of electron tubes have become reliable servants to man.

In Industry there has been an ever increasing demand for electronic control to insure greater production; a better, more uniform finished product; and direct savings in labor and material above the cost of the electronic equipment. But the number of actual installations, as compared with the possibilities are very few. Probably two reasons for this delay in making these needed installations are as follows:

1) Lack of proper information in the hands of the executives who have charge of new tool design, of what can be done with the electron tubes.

2) The thought of many, that a Standard Light Relay, or "Electric Eye Unit" will solve all of their problems from measuring to matching colors, and then the utter disappointment, when they find it cannot be done without added special equipment, the source of which is usually hard to find.

While it is true that Standard Light Relay Units, which are inexpensive, and very reliable will actuate an electric counter with no friction with the article that is being counted; protect punch press operators, open and close doors, and many other interesting and novel jobs; nevertheless, when accurate high speed, frictionless measurement of articles to .0005" is required, not only the optical problem presents itself; but with optical magnification, the intensity of the light falls off very rapidly, and so the standard unit cannot be used.

Photo-electric Temperature control unit, with self contained Electronic Time Delay, used in heat treating the tip of valve stems.

An interesting, recent installation of The Photo-electric Cell, which is reliable, and which actually saves money, is the control of the resistance heating of the valve stem. Because the photo-electric cell will control temperature accurately, and more rapidly than any other available agent; we may expect to see a number of resistance heating problems controlled in this manner in the future.

In selecting a photo-electric unit for temperature control, the following points must be taken into consideration.

1) The photo-electric Unit MUST NOT be effected by Solar or other Exterior light value changes. If the unit is effected by the changes from night to day, all accuracy is lost.

2) The Unit must be free from effects caused by supply line voltage fluctuations.

3) To control temperature to plus or minus ten degrees, the unit must be sensitive to changes of light of the order of one tenth foot candle of illumination.

4) The entire Unit must have a long life, and be free from early fatigue of "electric eye" or associated equipment.

The photo-electric temperature control on the resistance heater for heat treating the tip of the valve stem answers all of these requirements. The operator places the valve stem between the electrically driven dies. As soon as the dies have located the work, the heating current is turned on. As the valve stem comes up to correct temperature or color, the photo-electric cell turns off the heating current, and then by means of a reliable electronic time delay, the dies are opened .05 of a second later. This delay in opening the dies after the heating current is turned off eliminates any possibility of burning.

Similar Installations of this type are now being made for heating small billets for forging, for heat treating and annealing Pitman Arm Balls, for upsetting the end of drag links, and numerous other places where rapid, accurate control of temperature is required.

In measuring problems where ten to fifteen thousand articles have to be measured and graded per day; there is naturally considerable wear. To overcome this wear, and loss in accuracy, there seems but one solution, and that is to measure with a beam of light, and, yet, where measurements to one tenth of a thousandth are required the optical problem of magnification is not easily overcome. Roughly speaking, the intensity of light falls off by the square of the magnification. If this one tenth of a thousandth of an inch change in measurement, is to cast a shadow movement of one tenth of an inch, the magnification is about 1,000 to 1. If about 1,000 foot candles of light on the articles being measured

(Continued on page 15.)

OVER FIFTY THOUSAND ATTEND MACHINE TOOL SHOW

By WILSON B. FISKE,
CLEVELAND CORRESPONDENT
The Tool Engineer

The greatest operating machine shop in the world was thrown open to Machine Tool Show visitors at Cleveland, Ohio, Sept. 11-21, and original attendance estimates of the show management were almost doubled during this period. It was by far the biggest industrial spectacle ever presented.

A total of 238 exhibitors occupied 5.3 acres of floor space with approximately 900 machines ranging from the big hydraulic presses down to the smallest watch-making machine. It took about 400 freight cars to move the equipment into Cleveland from 16 states, and heavy trucking equipment bore it to the Exposition Hall and Public Auditorium without a slip. Weeks of planning was culminated with the setting up of the exhibits. Valuation of the final array was estimated at more than $3,000,000. Its weight was approximated at more than 2500 tons.

Besides the machinery exhibited by members of the National Machine Tool Builders' Association, there was a wide range of machinery other than machine tools, various accessories, and related products. Most of this was shown on the upper and lower floors of Public Auditorium while heavier machinery occupied the underground Exposition Hall. Practically everything moveable was connected with electric power and placed in operation for demonstration purposes. With the vast machine shop in motion, a total of 5,000 KW electrical current was required to pull the hourly load.

The exposition space was completely decorated in silver, black and red and the booths were arranged with wide aisles intervening. Many of the exhibitors had uniformed attendants in charge of every machine. Not only were they offering periodical demonstrations but many of the companies present had their men working in continuous production. The fact that from 6,000 to 10,000 pounds of chips and waste was carried out of the building every night indicates the scope of activity.

During the show a total of 5,000 people took part in the exhibition. These included shop mechanics, engineers, plant superintendents and executives. Due to the enthusiasm and interest shown, many company men were rushed to the show who had no previous expectation of being there. Other exhibitors relayed their attendance.

Real showmanship was exemplified in the manner in which exhibits were layed out. Machinery was lined up in systematic order with the salient points of demonstration open to public view. Larger exhibitors had a regular business secretary at a desk, a lounge for visitors, executives of authority to contract orders, technical engineers to explain the details of their products, and shop men to handle their operation. Practically every booth, large and small, drew the interest of the crowds.

The Pratt & Whitney Co. of Hartford, Conn., contracted the largest space in the show with 4590 feet. They also offered what was probably the most diversified array of products.

The Warner & Swasey Co. of Cleveland occupied almost a twin booth adjoining and the two companies shared the largest and most attractive lounge in Exposition Hall. In the center of the lounge was a miniature working model of one of the largest observatories in the world being built by the Warner & Swasey Co. for the University of Texas.

The Cincinnati Milling Machine Co. and Cincinnati Grinders Inc. had the most machines in operation at the show. They also had a total of 60 company representatives in charge during the period of ten days. Every one of the 25 machines had an operator in charge. It was called a "5 star show," featuring milling, grinding, lapping, broaching and die sinking.

The highest verticle machine on exhibition was a fast reverse, triple action, drawing press built by the Hydraulic Press Mfg. Co. of Gilead, Ohio, as a special job for the Transue & Williams Co. of Alliance, Ohio. This dramatic machine was 23 feet high and weighed 90,000 pounds.

The Ingersoll Milling Machine Co. boasted the heaviest machine on exhibition. It was a milling, drilling, boring, and thread cutting machine of almost human action, weighing 75 tons. This mammoth machine was transported and set up in sections.

The ExCello Aircraft and Tool Company had on display a new precision thread grinding machine —the only such machine at the show. This machine

This giant milling, drilling, boring and thread cutting machine weighed 75 tons and was the largest individual machine at the show.

will grind threads on hardened or heat treated work from the solid blank. We understand it is possible, with this machine, to hold a tolerance on the lead

not to exceed .0002" error per inch length or an accumulated error not in excess of .0006" on longer work. Pitch diameters on work up to one inch diameter will not vary more than .0002" and on larger diameters the same tolerance for each additional inch of diameter.

Outstanding exhibits were everywhere. In fact there were no dull corners and the crowds were fully interspersed. Great strides in machine tool design and application, during the past six years since the last show, were fully brought out. In general, the machines were larger, stronger, smoother. More automatic features were everywhere apparent. Increased production speeds were highly stressed by a multiplication of operations in the same machine while the closer precision offered a guarantee of better products. There was a much greater use of hydraulic power and more flexibility of action. Far less vibration meant longer life in the basic machine and far greater life in the attachments. New methods of manufacture requiring far less handling and a consequent step-up in production were available; threading and back-threading on the same piece without rehandling; boring, reaming, turning, facing and grooving on the same machine. In short, the 1935 show pictured the results of a great industrial revolution which has borne some of the greatest advancements of modern civilization.

Crowds at the Machine Tool Show were tremenduous. They surpassed the expectations of the most optimistic. The machine tool show management, prior to the event, predicted 30,000 visitors and such a figure would have pleased the exhibitors. The ultimate crowd ran over 50,000 to exceed all world records for an event of this kind. What is more, the general public was prohibited. Those in attendance were all legitimate, interested participants. Most of them were executives of the industrial field, engineers, expert mechanics, bankers, government officials and other connected parties.

Every state in the union was represented in substantial numbers. In addition, there were approximately 600 from foreign countries. Canada had over 250 in attendance. Germany had nearly 100. Russia and England were heavily represented. There were also delegations from France, Italy, Japan, Australia, India, Netherlands, Poland, Sweden, Czechoslovakia, Switzerland, Buenos Aires, Belgium, Panama, Venezuela, China, Ireland, Mexico, Palestine, Scotland, Alaska and Porto Rico.

Representatives of Dodge, Plymouth and Goddard & Goddard leave the A.S.T.E. boat for the show. Left to right Stan Grattan, "Doc" Gronow, Ed Rummins, W. J. Ziegler and "Bill" Tunis.

Actual registrations and one day passes totalled over 46,000. But aside from this, many special delegations from industrial firms and organizations as well as technical schools pased through the gates by special permission. The Cincinnati Milling Machine chartered a special train to bring nearly 900 of their employees to Cleveland. Other companies sent smaller delegations.

Friday, Sept. 13, was a big day at the show. It was the official "A.S.T.E. Day" at the show and several hundred members and friends arrived by boat from Detroit. After spending a pleasant night on board, the engineers took to land and inspected the big show during morning and afternoon. For many this was a big happy reunion with the renewal of old acquaintances in the machine tool field. After the show, a big informal dinner and meeting was held in Hotel Statler ballroom. The engineers did not leave on the return trip to Detroit until 11:30 P. M.

Another big arrival at the show was the special train of the Philadelphia Machinery Distributors on the Pennsylvania lines. This group spent three whole days at Cleveland. Other groups came in by land, air, rail and water.

Friday, Sept. 20, was designated as "Railroad Day" and many exhibitors featured special machinery for the production of locomotive and railroad equipment. Large delegations of railroad officials and maintenance men took in the show on that day.

The peak of attendance was reported on Saturday, Sept. 14, with over 22,000 spectators. The exposition hall was open daily from 9 A.M. to 6 P.M. throughout the show, excepting Sunday.

Foreign delegates registered in large groups every day. On Tuesday evening, Sept. 17, a special dinner was served in their honor by the National Machine Tool Builders Association.

Not only was the Machine Tool Show a huge success from the standpoint of displays and attendance but, what is probably more important, *business.* One executive expressed conditions in a fitting way when he said, "they came with their checkbooks". On this point, alone, the 1935 show differed considerably from the 1929 exposition. At that time officers and technical men were sent out as the delegates of manufacturing concerns but, generally, without the authority to buy. They checked the latest mechanical offerings against their own equipment and the future demand, and reported back to the board of directors. The latter considered the proposals and made recommendations. The business, therefore, came at a later date.

Conditions since 1929 have made the 1935 show far more important. The previous show did not follow a depression with curtailed buying. Neither did it come on the crest of a revolutionary wave in manufacture. Engineers and designers have been busily engaged while plants lay idle. The result has been an influx of new ideas and a radical change in the processes of production. A still more import-

ant factor which stimulated buying at the 1935 show was the definite need for equipment, spurred on by the necessity of competition.

For five years or more now, manufacturing plants have held off on normal requirements because of business conditions. Few would OK an expenditure when orders were falling off. Many figure on a machine paying for itself in a year. According to a generally standardized procedure, machinery is written completely off the books at the end of ten years. Theoretically, at least, that equipment is no longer a useful asset. No one cared to invest heavily when there was little promise of a return.

For a year or more now business has been on the uptrend and, with an influx of new orders, hundreds of plants find themselves poorly equipped. Some have installed equipment but the purchases have been relatively small compared to the need. Others waited for the grand showing at Cleveland when the last word in mechanical tools would be fully demonstrated and where the products of many companies could be compared.

Today there is a state of keen competition and obsolete machinery will not do. The successful concern now must compete in production and costs as well as quality, and modern machinery holds the answer. Where hundredths of an inch would do ten years ago, they are now measuring in thousandths of an inch. Guage blocks, seen at the show, will deal in millionths of an inch. Thus we see closer precision and minimized vibration in better products. On top of this we see the automatic and multiple features which reduce the cost of manufacture per unit.

Scheduled at the very eve of a gigantic market for capital goods, the Machine Tool Show of 1935 brought actual buyers to Cleveland in large numbers. Technical men accompanied executives with pretty definite intentions. Even curious plant men could not help but visualize the benefits of replacing present equipment with the new, and made recommendations to their superiors accordingly.

The result of all this enthusiasm and practical need was expressed in liberal buying right on the floor. Many of the exhibitors sold machines for immediate delivery direct from the show. Their customers refused to let the equipment go back to the factory. Reports from some of the booths show that every machine set up was sold before the close of the exhibition. Other orders were placed for substantial later deliveries. Show officials estimate over five million dollars in orders placed on the floor.

Delegates from foreign countries were among those who bought modern American machinery. The Amtorg Trading Corp., representing Soviet Russia, maintained an office in Public Auditorium and discussed business contracts during the show. Several companies reported that deliveries to other foreign countries had been considered. The aftermath of international transactions may run into millions of dollars.

Visitors to the Machine Tool Show left with the firm conviction that the depression is definitely over. Bright prospects in the automotive field, domestic appliance market, and other important avenues of trade, were freely discussed. The intermingling of big business men in an atmosphere of great activity had its positive effect. It was unanimously agreed that the machine tool business had reached a new promising era. The machinery on display will mark the production of the next five years at least. Most of the machines today are flexible enough to be retooled to meet changing conditions. It is believed by many that the engineers of the next two or three years will devote more time to attachments and accessories, and less time to the foundation machinery. With business on the uptrend, their problem may now be one of production engineering.

A view in the heavy machinery section with a mamouth drawing press 25 feet high, showing at the extreme right.

ELECTRONIC CONTROL

(Continued from page 12).

(any higher intensity would generate enough heat to expand the article being measured) are used, and this 1,000 foot candles is divided by 1,000,000, or the 1,000 magnification squared, it is easily appreciated that the differential between shadow and light would be too low a level for the human eye to distinguish.

Because the electric eye, or photo electric cell, with correct high gain amplification can be made sensitive enough to measure the intensity of the light of a star, it is the most logical answer to the outlined light measuring problem. The light beam piston pin measuring and grading machine, is a typical adaptation of the electric eye. The pilot lamps distinguish the various sizes, each a tenth of a thousandth of an inch apart. The pilot lamps are more quickly and easily read than a small pointer or hand on an indicator, and as a result the operator can accurately measure and grade about twice as many articles as could be done before. Of course, in place of the pilot lamps, electrically controlled chutes could be used, making the entire machine automatic.

The same general idea as carried out in this measuring machine, could be adapted to numerous other problems of measuring and grading.

(Continued on next page).

RELATIVE ACCURACY

The following is intended to assist in obtaining a clear conception of the relative accuracy of lengths, areas, and volumes when the given linear dimensions are expressed with a limit.

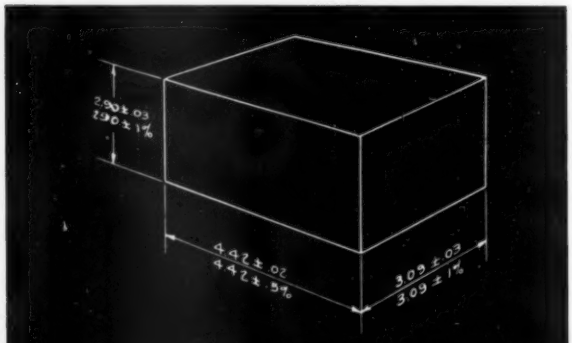


FIG. 1

	LENGTH		WIDTH		HEIGHT	
	IN.	RESIDUAL	IN	RESIDUAL	IN.	RESIDUAL
	4.46	.04	3.13	.04	2.95	.05
	4.40	.02	3.10	.01	2.85	.05
	4.45	.03	3.14	.05	2.90	.00
	4.43	.01	3.05	.04	2.90	.00
	4.38	.04	3.05	.04	2.85	.05
	4.42	.00	3.10	.01	2.95	.05
	6|26.54	6|.14	6|18.57	6|.19	6|17.40	6|.20
AVERAGE	4.42 ± .02		3.09 ± .03		2.90	.03
RELATIVE ERROR	0	.02 / 4.42		.03 / 3.09		.03 / 2.90
% ERROR		.5%		1%		1%

FIG 2

The block in Figure 1 is measured 6 times, the averages of these lengths are shown in Figure II. The difference between the average length and the measurements is called residual. Average length= average residual is the dimension to be used in the mathematical computations.

The actual, relative and percentage errors are changed accordingly as the operations of addition, subtraction, division, and multiplication are involved.

When linear dimensions are added or subtracted, the actual errors are added.

This means that if several lengths were added, the result would be correct even if all the lengths considered were equal to the low limit, or if all were equal to the high limit.

If two dimensions having actual errors are multiplied, it becomes necessary to add the relative errors, or since the relative errors expressed as decimals are similar to percentage errors, it is better to use percentage errors.

A study of the following will show why this is true:

$(A+2\%)\ (B+3\%) =$

$(A+2 \text{ of } A)\ (B+3\% \text{ of } B) =$

$(1.02\ A)\ (1.03\ B) = 1.0506\ A.B. = AB + 5\% \text{ of } AB = AB + 5\%$

$(A-2\%)\ (B-3\%) =$

$(.98 \text{ of } A)\ (.97\ B) = .9506\ AB = AB - 5\% \text{ of } AB = AB - 5\%$

Since $(A+2\%)\ (B+3\%) = AB+5\%$, and $(A-2\%)\ (B-3\%) = AB-5\%$ it follows that $(A\pm2\%)\ (B\pm3\%) = AB\pm5$.

$$\frac{A+2\%}{B-3\%} = \frac{A+2\% \text{ of } A}{B-3\% \text{ of } B} = \frac{1.02A}{.97B} = 1.05$$

$$\frac{A}{B} = \frac{A}{B}+5\% \text{ of } \frac{A}{B} = \frac{A}{B}+5\%$$

$$\frac{A-2\%}{B+3\%} = \frac{A-2\% \text{ of } A}{B+3\% \text{ of } B} = \frac{.98A}{1.03B} = .95$$

$$\frac{A}{B} = \frac{A}{B}-5\% \text{ of } \frac{A}{B} = \frac{A}{B}-5\%$$

$$\text{Then } \frac{A\pm2\%}{B\pm3\%} = \frac{A}{B}\pm5\%$$

ELECTRONIC CONTROL

(Continued from preceding page)

Today photo-electric cells, and a beam of light are used to accurately cut off lengths of clay, as used for spark plug ceramics, as the clay is extruded in a soft form from a pug machine. There is no frictional contact with the clay to determine the time for operation of the cut off wire, with a resulting accurate pug. Carburetor Air Cleaners are automatically spray painted as they pass before an electric eye on a conveyor, with a resulting savings in paint.

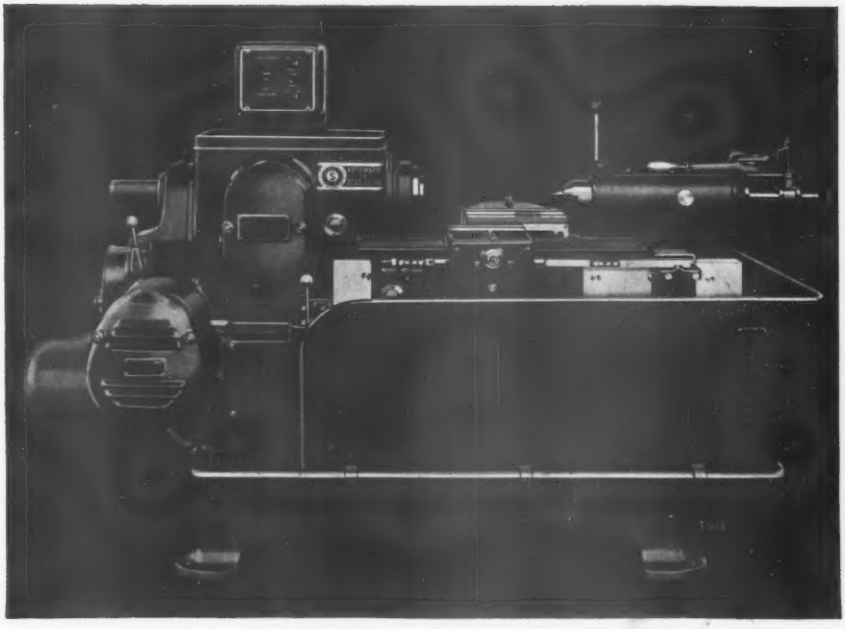
A few of the recent photo-electric or electric eye installations made in the industrial field are listed here, so that tool engineers may obtain some idea of how easily and rapidly not only the electric eye, but other electronic tubes can solve their problems:

Reversing rolls in steel mills
Removal of soaking pit covers
Control of Cut-off saws
Furnace temperature control
Controlling thickness of sinter beds
Smoke indicators in smoke stacks
Detecting fine cracks in polished surfaces
Automatic opening doors for trucks
Warning Signals on rolls in tire factories
Safety protection of machines
Detection of flaws
Analysis of card records
Turning threads on pipe
Piling bags on conveyor
Pressure application on testing welds
Pre selective conveyor dispatching system
Automatic weighing
Registering printing, folding and cut offs.
Inspect Storage Battery Caps for vent holes
Flagging tote pans on a conveyor at selected stations
Controlling thickness of enamel on wires
Rejection of non sharp razor blades
Calipering steel balls automatically
Automatic sheet catcher in steel mills
Grading Cigars, tile, beans, lemon and oranges
Detecting missing labels

(Continued on page 18).

Sensational!

- ★ NEW TYPE HARDENED STEEL WAYS
- ★ NEW QUICK SET-UP
- ★ NEW SPEED OF OPERATION
- ★ RAPID TRAVERSES OF 250″ PER MINUTE
- ★ AUTOMATIC LUBRICATION
- ★ SIMPLIFIED ELECTRICAL CONTROL



The Automatic 10″ Stub Lathe

Demonstrated in public for the first time at the Machine Tool Show, the Sundstrand Automatic 10″ Stub Lathe is really sensational. It has the high accuracy, rigidity, strength, durability and economy that have made Sundstrand machine tools well and favorably known in leading metal working plants everywhere. In addition, it has many new features that cut cost and increase production on the wide variety of work within its capacity. High speed is an outstanding characteristic of this machine—the speed of set-up, the speed with which tools get to work, the speed with which the tools finish their work, the unusually high speed with which the tools return to starting position. This is all accomplished in a smooth, shockless, easily adjusted automatic operating cycle. Nothing is sacrificed to secure high speed operation. Hardened and ground steel ways, wide-spread use of anti-friction bearings, automatic lubrication, extreme simplicity of design and careful selection of materials, all contribute to maintaining high accuracy throughout a long life.

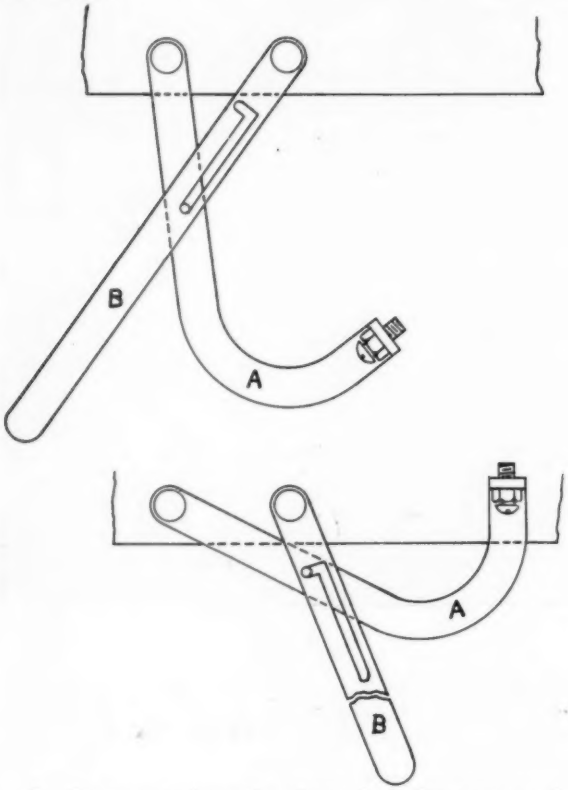
Sundstrand Automatic 10″ Stub Lathes are made in four models and four lengths. They are illustrated and described in a new circular that we shall be glad to send to interested executives promptly on request.

STERLING-FRENCH MACHINERY CO.
NEW CENTER BUILDING ♦ DETROIT, MICHIGAN ♦ PHONE MADISON 3660
Exclusive Sales Representatives for Sundstrand Products in the Detroit Territory

A QUICK-ACTING, SELF-LOCKING CLAMP

BY L. KASPER
A.S.T.E. MEMBER
PHILADELPHIA, PA.

The sketches show two plane views of a simple jig clamp which is self locking, quick releasing and provides ample clearance for inserting and removing the work.



In the upper view, the clamp is in its open position, the lower view shows it locked. Levers A and B are pivoted to swing freely. Lever A carries a pin which moves freely in the L shaped slot in lever B. Moving lever B to the right causes lever A to swing on a pivot, by the action of the pin in the L slot. As the pin rides into the short leg of the L slot, lever A is locked positively against reversal of movement. Movement of lever B to the left, immediately unlocks lever A and swings it away from the work.

As shown, the clamp is suitable for light work; modification may be necessary to suit the job at hand, but the idea is worth remembering.

FOUNDRYMEN'S ASSOCIATION PUBLISH CAST METALS HANDBOOK

This handbook is the first ever published devoted exclusively to the properties and application of cast materials. It brings up to date information on castings and corrects much eroneous and obsolete data. Many tool engineers have need for this handbook which may be purchased through the Secretary's Office of the American Society of Tool Engineers, 31 Melbourne Ave., Detroit, Mich. Price $4.00.

A.S.T.E. STANDARDIZATION PROGRAM

(*Continued from page* 11).

change in product such as the automobile industry there are many machines which are re-tooled every year or so. Everytime one of these machines is re-tooled it becomes necessary for the tool designer to take certain measurements of the machine to insure the use of the tool or fixture on the machine to which it is assigned. This involves considerable time on the part of the designer and after he has finished his work it is passed on to a design checker who in turn follows the same routine. This consumes much time and at a time when every minute counts and delays prove expensive. If each plant were to make drawings of the machines in their production lines a great part of this lost time could be saved but the expense involved would be enormous. To offset this, the Standards Committee of the A.S.T.E. propose the issuing of a data sheet having blank spaces for filling in the more important dimensions. These will be standard as to size but will be printed on vellum paper and on one side of the sheet only so that they can be blueprinted and the blueprints filled in with proper dimensions. These blueprints can be filed under the plant equipment or brass tag number and are available when needed. This will undoubtedly result in a great saving of time to the designer and expense to his employer. The only machines on which blank data sheets will be issued are those that are most common such as drill presses, milling machines, lathes, grinders, broaches etc., and only on the older models as we hope to have a regular standard data sheet on all the latest, improved equipment.

The expense of these data sheets will be borne by the companies or corporations manufacturing the machine tool or equipment being described, but the advertising value will be worth many times the cost.

These data sheets will be sent by the Society to society members only, although the sponsor has the privilege of sending them to anyone and in any quantity he desires. The best way to insure receiving all the sheets and as soon as they are issued is to join the society if you are not already a member.

With this recommendation, the A.S.T.E. Standard Machine and Tool Data Sheets are dedicated to the Engineering profession as a whole and the Tool Engineer in particular, whether vendor or user of mechanical equipment. It is our belief that they will fill a long felt need and serve a useful purpose.

ELECTRONIC CONTROL

(*Continued from page* 16).

Color control, comparison and matching

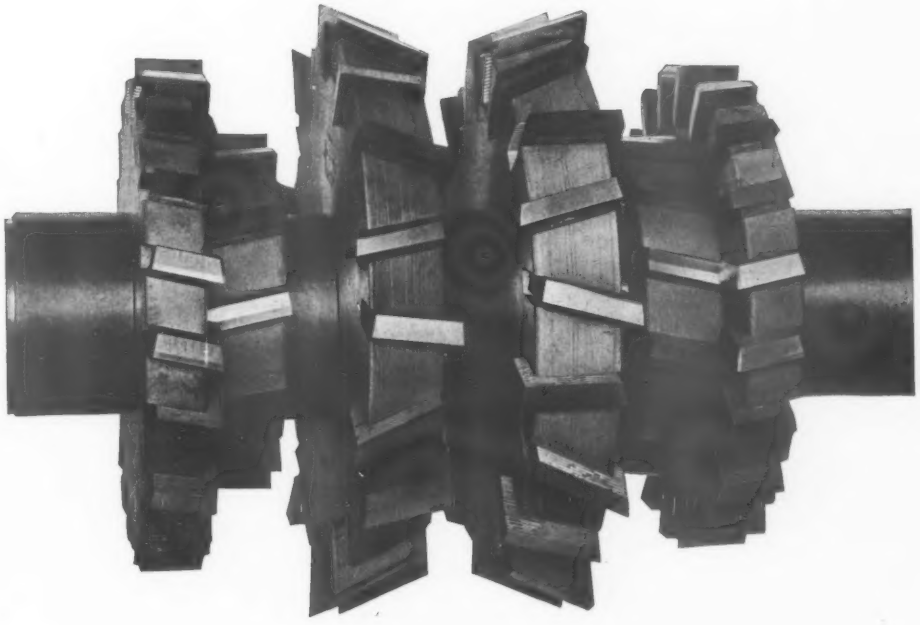
Automatic adjustment of Automobile headlamps and thousands of others.

In Industry today we find The Cathode Ray Tube, and associated equipment used to analyze sound, to determine the location of one frequency, which is causing, with other frequencies a hetrodyne, or rumble. Electronic tubes as used in Time Delays offer the most accurate method of delaying one action for a pre-adjusted period of time, after another operation has either been completed or started.

To day, the electric eye can be used in almost every place, where in production the human eye has been depended upon. But the "electric eye" never winks, and never sleeps.

G&D & G&D Inserted Milling Cutters made of the serrated blade and wedge construction positively hold the blades against slipping. This has been proven by the application of this construction to the heaviest class of milling over a period of e i g h t y e a r s .

As a further advantage of this construction the blades can be adjusted radially in increments of the pitch of the serrations (1/16″) or axially to any position, the adjustments being entirely independent of each other. The supposedly correct ratio of adjustment of peripheral and side cutting edges of face mills for your job is not predetermined by the manufacturer nor limited by mechanical construction.



The above Gang consisting of Half Side Mills, Plain Mills, and Staggered Tooth Angular Cutters illustrates the universal adaptability of this construction.

GODDARD & GODDARD CO.

DETROIT, MICH.

New Literature

National Twist Drill & Tool Company, Detroit, Michigan—new Catalog No. 15. Durably bound, contains full information on the company's drills, reamers, milling cutters, hobs and special tools.

Landis Tool Company, Waynesboro, Pa. Catalog 031 describes the Landis Tool & Cutter Grinder 12x32.

Standard Gage Company, Poughkeepsie, N. Y. Catalog No. 6A complete description of the company's line of dial and limit gages

Prosser — Cemented Carbide Tool Grinder—circular, describing this new machine of the Thos. Prosser & Son , 15 Gold Street, New York City

For Grinder Men Only— attractive booklet describing practical "hows" and "whys" and "wherefores" of diamond tools. Address Koebel Diamond Tool Co., Detroit, Michigan

National Tool Company, Cleveland, Ohio. Catalog J—describes arbors, cutters, end mills, gear shapers, hobs and counterbores.

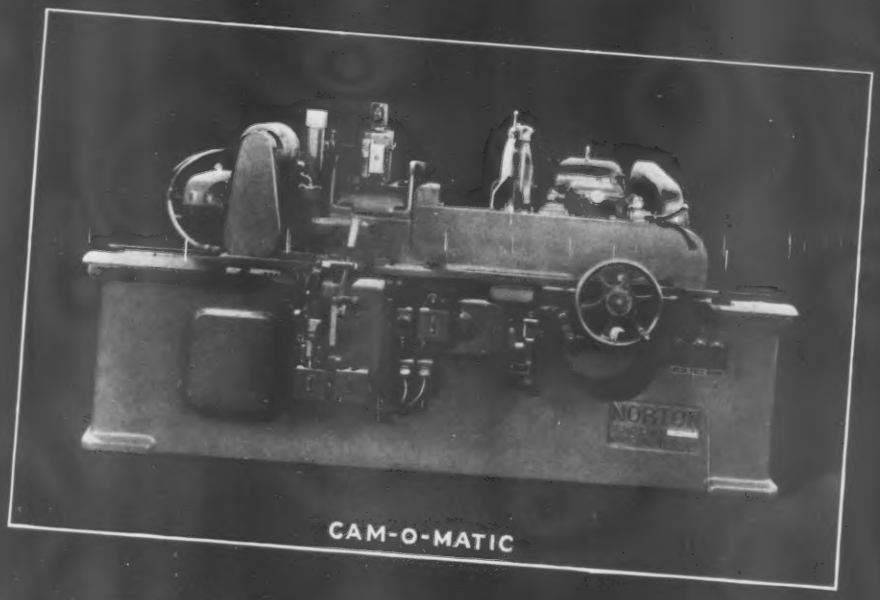
Ross Operating Valve Company, Detroit, Michigan describes 4 way, 3 way, Foot Operated, Locking and Non-locking air operating valves.

Cogsdill Mfg. Co., Detroit, Michigan. Catalog 6. Complete description of company's standard drills, reamers, end mills, cutters and special tools.

When writing for this literature please mention *The Tool Engineer*

2 New Norton Grinders
For The Automotive Industry

D-86 CRANKPIN GRINDER



CAM-O-MATIC

NORTON
GRINDING & LAPPING
MACHINES

New bulletins on these two grinders are available
—Copies will be sent on request—
NORTON COMPANY, WORCESTER, MASS.

THIS MONTH'S COVER

INTERNAL INDICATOR

The demand for greater precision in machining operations requires improved methods for accurately checking the work not only on the inspection line, but also at the machine, in order to control size as parts are being finished to reduce to a minimum the chances of producing scrap.

Precision boring of cylinder blocks with single point tungsten carbide tools is just one example of an improved method which produces a more uniform product. Because of the exacting requirements on roundness and straightness of bore, it is necessary to use a gage which shows variations in out of round and taper to tenths of thousandths. Because the part is bulky, the gaging operation requires a light convenient gage, such as the operator is using. The gage illustrated is an internal indicator offered by the Swedish Gage Company of America, Detroit, for checking bores from 3" to 6" diameter and up to 10" deep. By using extension gaging anvils the range can be increased to 10" diameter; and with extension bodies, depths up to 24" can be gaged.

An exclusive feature of the gage is the arrangement of the locating fingers which make it possible to set to zero either with a master ring or direct from gage blocks. Because of this feature, the gage can be used as a means of checking the master ring against the gage blocks which serve as the master standard. The action of the locating fingers centers the gage in the bore and keeps the two measuring points in the correct position to check the true diameter of the hole, thus giving rapid accurate measurements even when used by an unskilled operator.

The design of the indicating mechanism is unique, employing the knife edge and lever principle of amplification. Levers are arranged to permit the use of two pointers. One pointer registers ten-thousandths and the other thousandths.

The scale range is plus or minus 0".001 in stepss of 0".0001 and minus 0./20 in steps of 0".001. This permits the use of the gage in semi-finished holes to determine the amount of stock to be removed, and makes it very convenient for use in setting up internal grinding, precision boring or honing machines. It is of course, equally convenient for checking the finished parts coming off the machine and on the inspection line for a final check. Scale divisions are of sufficient width to easily detect variations of as little as 0".00005.

Construction of moving parts is rugged enough to stand up in continuous production, and when used around machines, the body can be sealed against the entrance of grit or coolants. In addition to the gage illustrated, other sizes are available for checking bores from a minimum of 3/8" in diameter. To prevent rapid wear of the measuring points, tungsten carbide tips may be applied where necessary.

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